



TENTATIVE

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12.1" SVGA

TECHNICAL SPECIFICATION

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AA121SP07

MITSUBISHI ELECTRIC Corp.

Date: Dec.8,'09



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1. APPLICATION

This specification applies to color TFT-LCD module, AA121SP07.

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(1) Standard Usage

Computers, office equipment, factory automation equipment, test and measurement equipment, communications, transportation equipment(automobiles, ships, trains, etc.), provided, however, that operation is not influenced by TFT-LCD directly.

(2) Special Usage

Medical equipment, safety equipment, transportation equipment, provided, however, that TFT-LCD is necessary to its operation.

(3) Specific Usage

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2. OVERVIEW

AA121SP07 is 12.1" color TFT-LCD (Thin Film Transistor Liquid Crystal Display) module composed of LCD panel, driver ICs, control circuit, and backlight unit.

By applying 6 bit or 8 bit digital data, 800×600 , 262k-color or 16.7M-color images are displayed on the 12.1" diagonal screen. Input power voltage is 3.3V for LCD driving.

The type of data and control signals are digital and transmitted via LVDS interface per Typ. 40MHz clock cycle.

Inverter for backlight is not included in this module. General specifications are summarized in the following table:

ITEM	SPECIFICATION
Display Area (mm)	246.0(H) $\times$ 184.5(V) (12.106-inch diagonal)
Number of Dots	800×3 (H) $\times$ 600 (V)
Pixel Pitch (mm)	0.3075 (H) $\times$ 0.3075 (V)
Color Pixel Arrangement	RGB vertical stripe
Display Mode	Normally white TN
Number of Color	262k(6 bit/color), 16.7M(8 bit/color)
Luminance (cd/m ²)	450
Wide Viewing Angle Technology	Optical Compensation Film
Viewing Angle (CR $\geq$ 10)	-80~80° (H), -55~75° (V)
Surface Treatment	Anti-reflection and hard-coating 2H
Electrical Interface	LVDS (6 bit/8 bit)
Optimum Viewing Angle(Contrast ratio)	6 o'clock
Module Size (mm)	280.0 (W) $\times$ 210.0 (H) $\times$ 12.0 (D)
Module Mass (g)	770
Backlight Unit	CCFL, 2-tubes, edge-light, replaceable

Characteristic value without any note is typical value.

3. ABSOLUTE MAXIMUM RATINGS

ITEM	SYMBOL	MIN.	MAX	UNIT
Power Supply Voltage for LCD	VCC	0	4.0	V
Logic Input Voltage	VI	-0.3	VCC+0.3	V
Lamp Voltage	VL	0	2000	Vrms
Lamp Current	IL	0	18	mA _{rms}
Lamp Frequency	FL	--	100	kHz
Operation Temperature (Panel) Note 1,2)	T _{op(Panel)}	-30	80	°C
Operation Temperature (Ambient) Note 2)	T _{op(Ambient)}	-30	80	°C
Storage Temperature Note 2)	T _{stg}	-30	80	°C

[Note]

1) Measured at the center of active area and at the center of panel back surface

2) Top, Tstg ≤ 40°C : 90%RH max. without condensation

Top, Tstg > 40°C : Absolute humidity shall be less than the value of 90%RH at 40°C without condensation.

4. ELECTRICAL CHARACTERISTICS

(1) TFT-LCD

Ambient temperature: Ta = 25°C

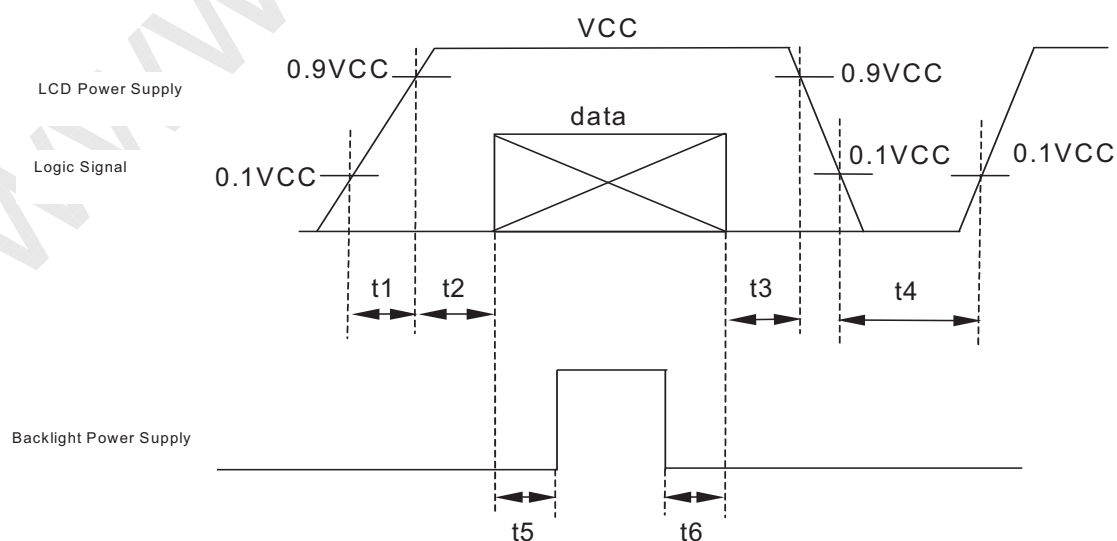
ITEM	SYMBOL	MIN.	TYP.	MAX.	UNIT	Remarks
Power Supply Voltages for LCD	VCC	3.0	3.3	3.6	V	*1)
Power Supply Currents for LCD	ICC	--	370	550	mA	*2)
Permissive Input Ripple Voltage	VRP	--	--	100	mVp-p	VCC = +3.3V
Logic Input Voltage	High	VIH	0.8×VCC	--	V	MODE, SC
	Low	VIL	0	--	V	MODE, SC

*1) Power and signals sequence:

$$t1 \leq 10 \text{ ms} \quad 200 \text{ ms} \leq t4$$

$$0 < t2 \leq 50 \text{ ms} \quad 200 \text{ ms} \leq t5$$

$$0 < t3 \leq 50 \text{ ms} \quad 0 \leq t6$$

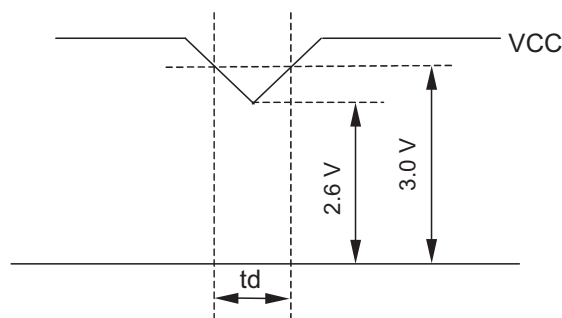


data: RGB DATA, DCLK, DENA, MODE, SC

VCC-dip conditions:

- 1) When $2.6\text{ V} \leq \text{VCC} < 3.0\text{ V}$, $t_d \leq 10\text{ ms}$
- 2) When $\text{VCC} < 2.6\text{ V}$

VCC-dip conditions should also follow the power and signals sequence.



*2) $\text{VCC} = +3.3\text{ V}$, $f_H = 37.9\text{ kHz}$, $f_V = 60\text{ Hz}$, $f_{\text{CLK}} = 40\text{ MHz}$

Display image at typical power supply current value is 256-gray-bar pattern (8 bit), 600 line mode.

*3) Fuse

Parameter	Fuse Type Name	Supplier	Remark
VCC	FCC16162AB	Kamaya Electric Co., Ltd.	*)

*) The power supply capacity should be designed to be more than the fusing current.

(2) Backlight

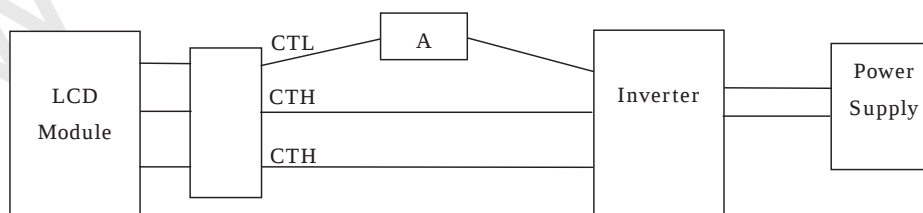
$T_a = 25^\circ\text{C}$

ITEM	SYMBOL	MIN.	TYP.	MAX.	UNIT	Remarks
Lamp Voltage	VL	--	540	--	Vrms	$I_L = 12.0\text{ mArms}$
Lamp Current	IL	6.0	12.0	14.0	mArms	*2), *6)
Lamp Frequency	FL	30	--	70	kHz	*3)
Starting Lamp Voltage	VS	1000	--	--	Vrms	$T_a = 25^\circ\text{C}$
		1200	--	--		$T_a = 0^\circ\text{C}$
		1320	--	--		$T_a = -30^\circ\text{C}$
Lamp Life Time	LT	50000	--	--	h	*4), *5) $I_L = 12.0\text{ mArms}$, Continuous operation

[Note]

*1) Please use synchronous inverter.

*2) Lamp Current measurement method (The current meter is inserted in low voltage line.)



*3) Lamp frequency of inverter may produce interference with horizontal synchronous frequency, and this may cause horizontal beat on the display. Therefore, please adjust lamp frequency, and keep inverter as far from module as possible or use electronic shielding between inverter and module to avoid the interference.

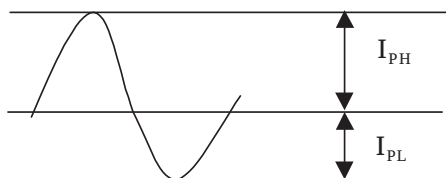
*4) Lamp life time is defined as the time either when the brightness becomes 50% of the initial value, or when the starting lamp voltage does not meet the value specified in this table.

*5) The life time of the backlight depends on the ambient temperature. The life time will decrease under low/high temperature.

*6) Please use the inverter which has symmetrical current wave form as follows,

The degree of unbalance: less than 10%

The ratio of wave height: less than $\sqrt{2} \pm 10\%$



I_{PH} : High side peak

I_{PL} : Low side peak

The degree of unbalance = $|I_{PH} - I_{PL}| / I_{rms} \times 100(\%)$

The ratio of wave height = $I_{PH}(\text{or } I_{PL}) / I_{rms}$

CURRENT WAVE FORM

5. INTERFACE PIN CONNECTION

(1) CN 1(Interface Signal)

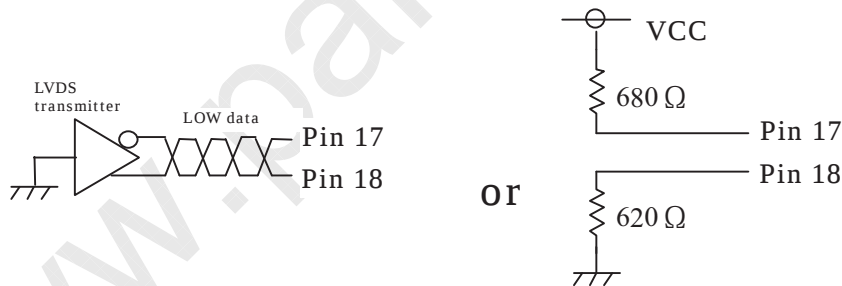
Used connector: FI-SEB20P-HFE (JAE)

Corresponding connector: FI-S20S[for discrete Wire] (JAE) , FI-SE20ME[for FPC] (JAE)

Pin No.	Symbol	Function(ISP 6 bit compatibility mode)		Function(ISP 8 bit compatibility mode)
		6 bit input	8 bit input	
1	VCC	+3.3 V Power supply		←
2	VCC	+3.3 V Power supply		←
3	GND	GND		←
4	GND	GND		←
5	Link 0-	R0, R1, R2, R3, R4, R5, G0	R2, R3, R4, R5, R6, R7, G2	R0, R1, R2, R3, R4, R5, G0
6	Link 0+	R0, R1, R2, R3, R4, R5, G0	R2, R3, R4, R5, R6, R7, G2	R0, R1, R2, R3, R4, R5, G0
7	GND	GND		←
8	Link 1-	G1, G2, G3, G4, G5, B0, B1	G3, G4, G5, G6, G7, B2, B3	G1, G2, G3, G4, G5, B0, B1
9	Link 1+	G1, G2, G3, G4, G5, B0, B1	G3, G4, G5, G6, G7, B2, B3	G1, G2, G3, G4, G5, B0, B1
10	GND	GND		←
11	Link 2-	B2, B3, B4, B5, DENA	B4, B5, B6, B7, DENA	B2, B3, B4, B5, DENA
12	Link 2+	B2, B3, B4, B5, DENA	B4, B5, B6, B7, DENA	B2, B3, B4, B5, DENA
13	GND	GND		←
14	CLKIN-	Clock -		←
15	CLKIN+	Clock +		←
16	GND	GND		←
17	Link3-	See: *2)	R0, R1, G0, G1, B0, B1	R6, R7, G6, G7, B6, B7
18	Link3+	See: *2)	R0, R1, G0, G1, B0, B1	R6, R7, G6, G7, B6, B7
19	MODE	Low=ISP 6 bit compatibility mode		High=ISP 8 bit compatibility mode
20	SC	Scan direction control. (Low : Normal , High : Reverse)		←

*1) Metal frame is connected to signal GND.

*2) Recommended wiring of Pin 17,18 (6 bit input)



(2) CN 2(Backlight)

Backlight-side connector: BHR-03(4-3)VS-1N (JST)

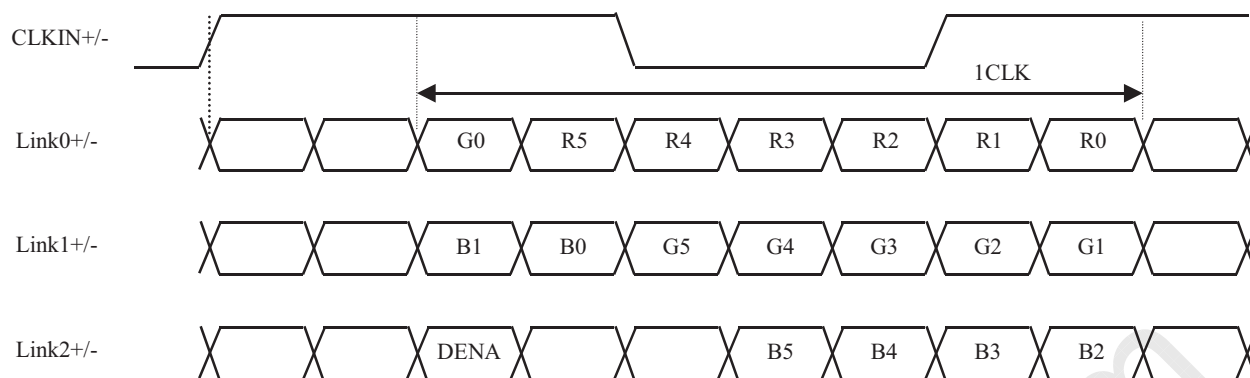
Inverter-side connector: SM04(4.0)B-BHS(LF)(SN) (JST)

Pin No.	Symbol	Function
1, 2	CTH	VBLH (High voltage)
3	CTL	VBLL (Low voltage)

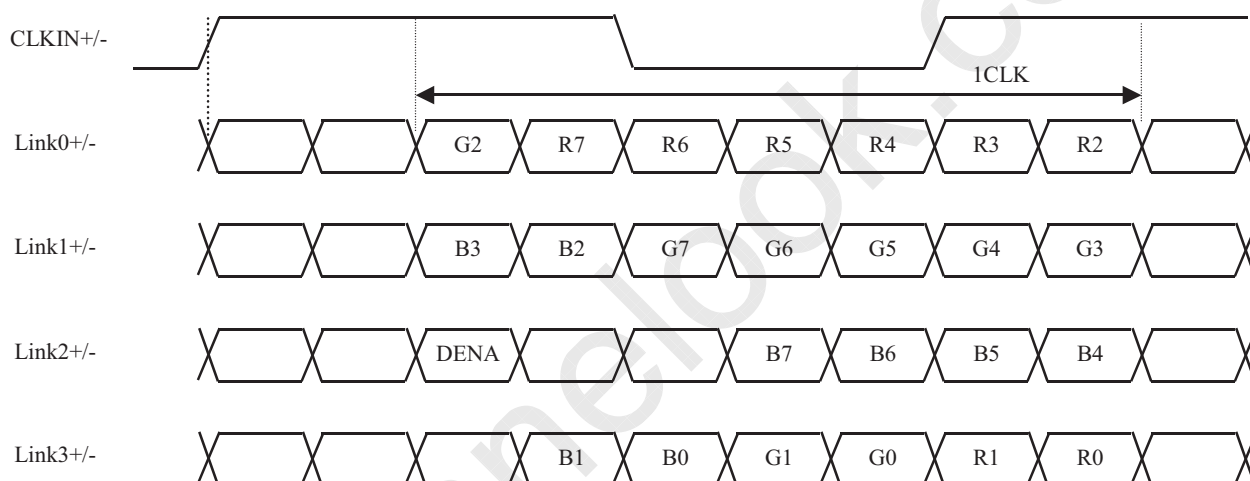
[Note] VBLH - VBLL = VL

(3) ISP data mapping

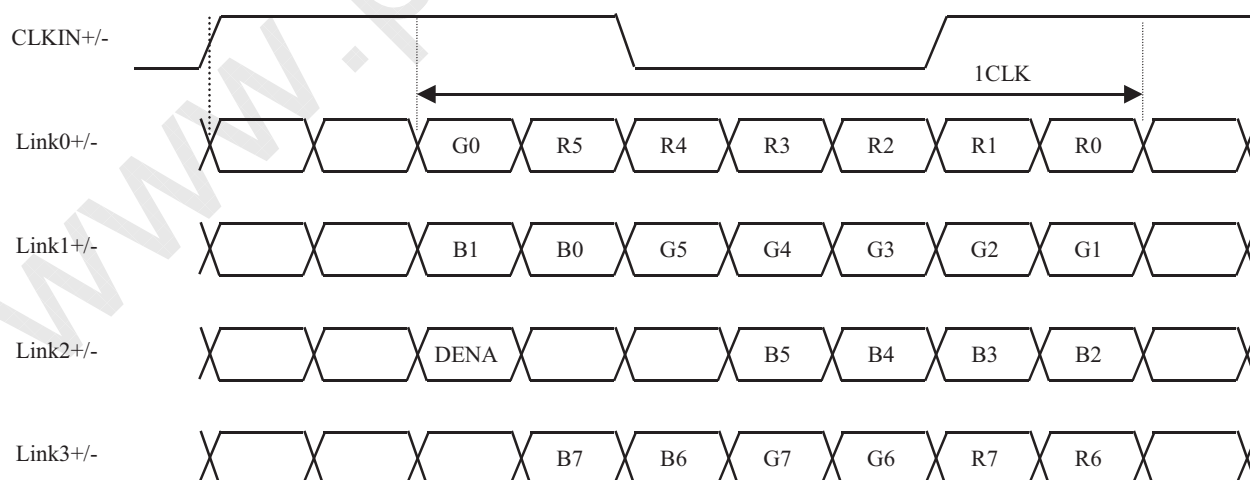
a. ISP 6 bit compatibility mode(6 bit input)



b. ISP 6 bit compatibility mode(8 bit input)



c. ISP 8 bit compatibility mode



6. INTERFACE TIMING

LVDS transmitter input signal

(1) Timing Specifications

ITEM			SYMBOL	MIN	TYP	MAX	UNIT
DCLK	Frequency		f _{CLK}	35	40	42	MHz
	Period		t _{CLK}	23.8	25	28.6	ns
DENA	Horizontal	Active Time	t _{HA}	800	800	800	t _{CLK}
		Blanking Time	t _{HB}	20	256	--	t _{CLK}
		Frequency	f _H	35.2	37.9	39.2	kHz
		Period	t _H	25.5	26.4	28.4	μs
	Vertical	Active Time	t _{VA}	600	600	600	t _H
		Blanking Time	t _{VB}	3	28	--	t _H
		Frequency	f _V	55	60	64.2	Hz
		Period	t _V	15.6	16.7	18.2	ms

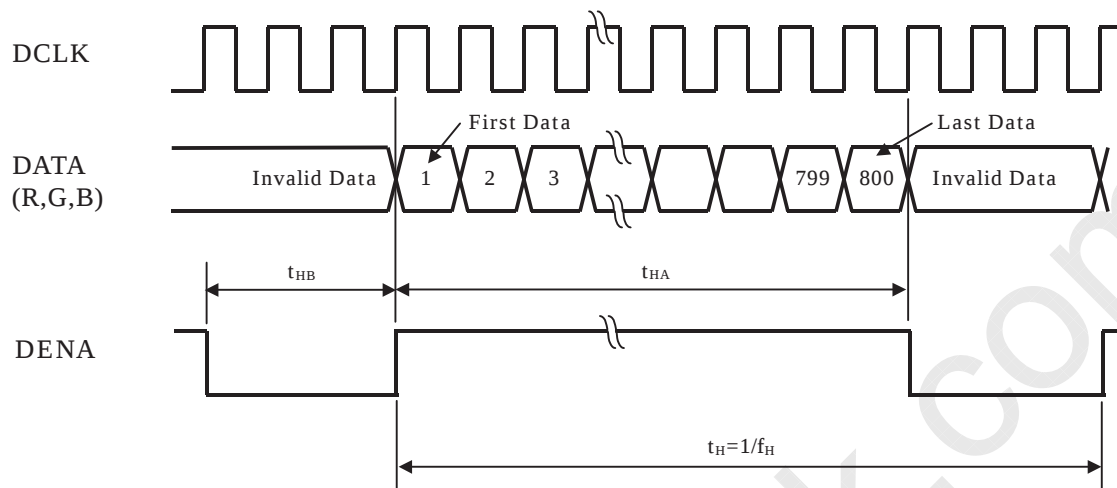
[Note]

- 1) DENA (Data Enable) should always be positive polarity as shown in the timing specification.
- 2) DCLK should appear during all invalid period.
- 3) LVDS timing follows the timing specifications of LVDS receiver IC: THC63LVDF84B(Thine).
- 4) In case of blanking time fluctuation, please satisfy following condition.

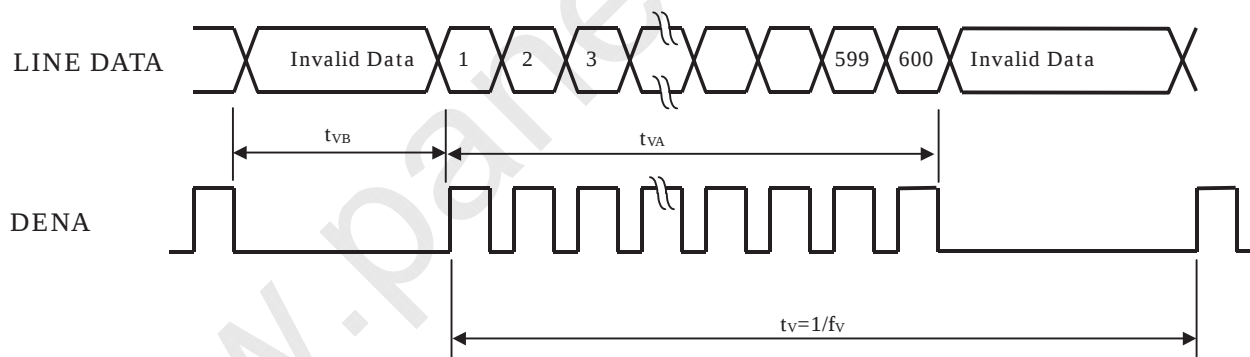
$$t_{VBn} > t_{VBn-1} - 3(t_H)$$

(2) Timing Chart

a. Horizontal Timing Chart



b. Vertical Timing Chart



(3) Color Data Assignment

a. 6 bit input

COLOR		INPUT DATA																	
		R DATA						G DATA						B DATA					
		R5	R4	R3	R2	R1	R0	G5	G4	G3	G2	G1	G0	B5	B4	B3	B2	B1	B0
		MSB					LSB	MSB					LSB	MSB					LSB
BASIC COLOR	BLACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RED(63)	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
	GREEN(63)	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
	BLUE(63)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
	CYAN	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1
	MAGENTA	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1	1
	YELLOW	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0
	WHITE	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
RED	RED(1)	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
	RED(2)	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	RED(62)	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	RED(63)	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
GREEN	GREEN(1)	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
	GREEN(2)	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
	GREEN(62)	0	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0	0
	GREEN(63)	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
BLUE	BLUE(1)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	BLUE(2)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
	BLUE(62)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	0
	BLUE(63)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1

[Note]

1) Definition of gray scale

Color (n) --- n indicates gray scale level.

Higher n means brighter level.

2) Data

1:High, 0: Low

b. 8 bit input

COLOR		INPUT DATA																							
		R DATA								G DATA								B DATA							
		R7	R6	R5	R4	R3	R2	R1	R0	G7	G6	G5	G4	G3	G2	G1	G0	B7	B6	B5	B4	B3	B2	B1	B0
MSB				LSB				MSB				LSB				MSB				LSB					
BASIC COLOR	BLACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	RED(255)	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	GREEN(255)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	
	BLUE(255)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	
	CYAN	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
	MAGENTA	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	
	YELLOW	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	
	WHITE	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
RED	RED(1)	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	RED(2)	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
	RED(255)	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
GREEN	GREEN(1)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	
	GREEN(2)	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0		
	GREEN(255)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	
BLUE	BLUE(1)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	
	BLUE(2)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0		
	BLUE(255)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	

[Note]

1) Definition of gray scale

Color (n) --- n indicates gray scale level.

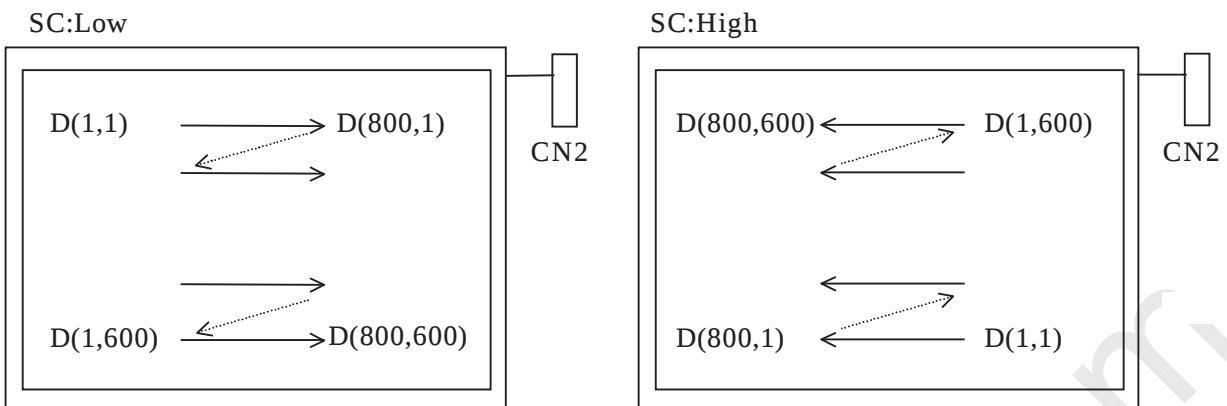
Higher n means brighter level.

2) Data

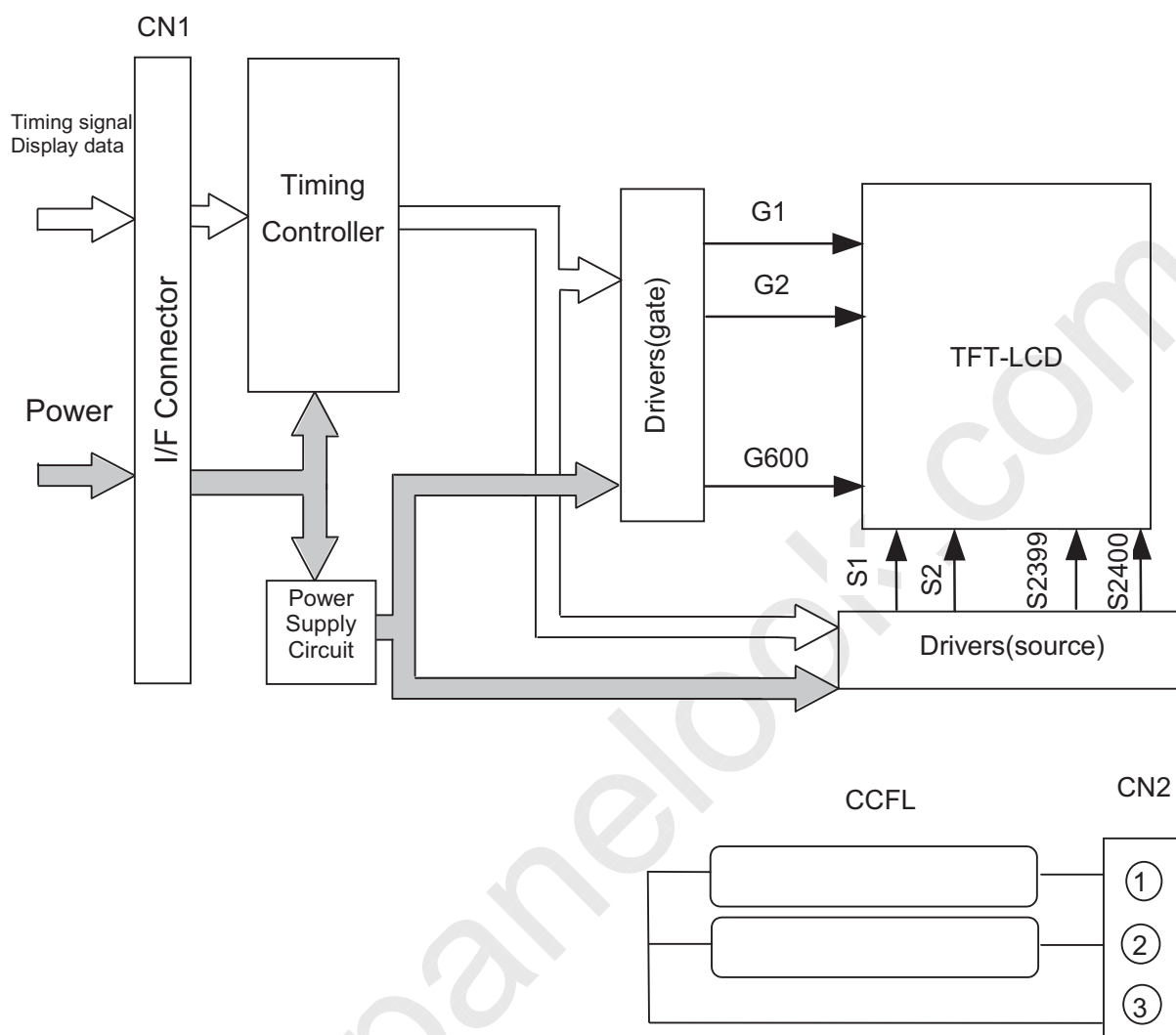
1:High, 0: Low

(4) Display Position and Scan Direction

D(X,Y) shows the data number of input signal.

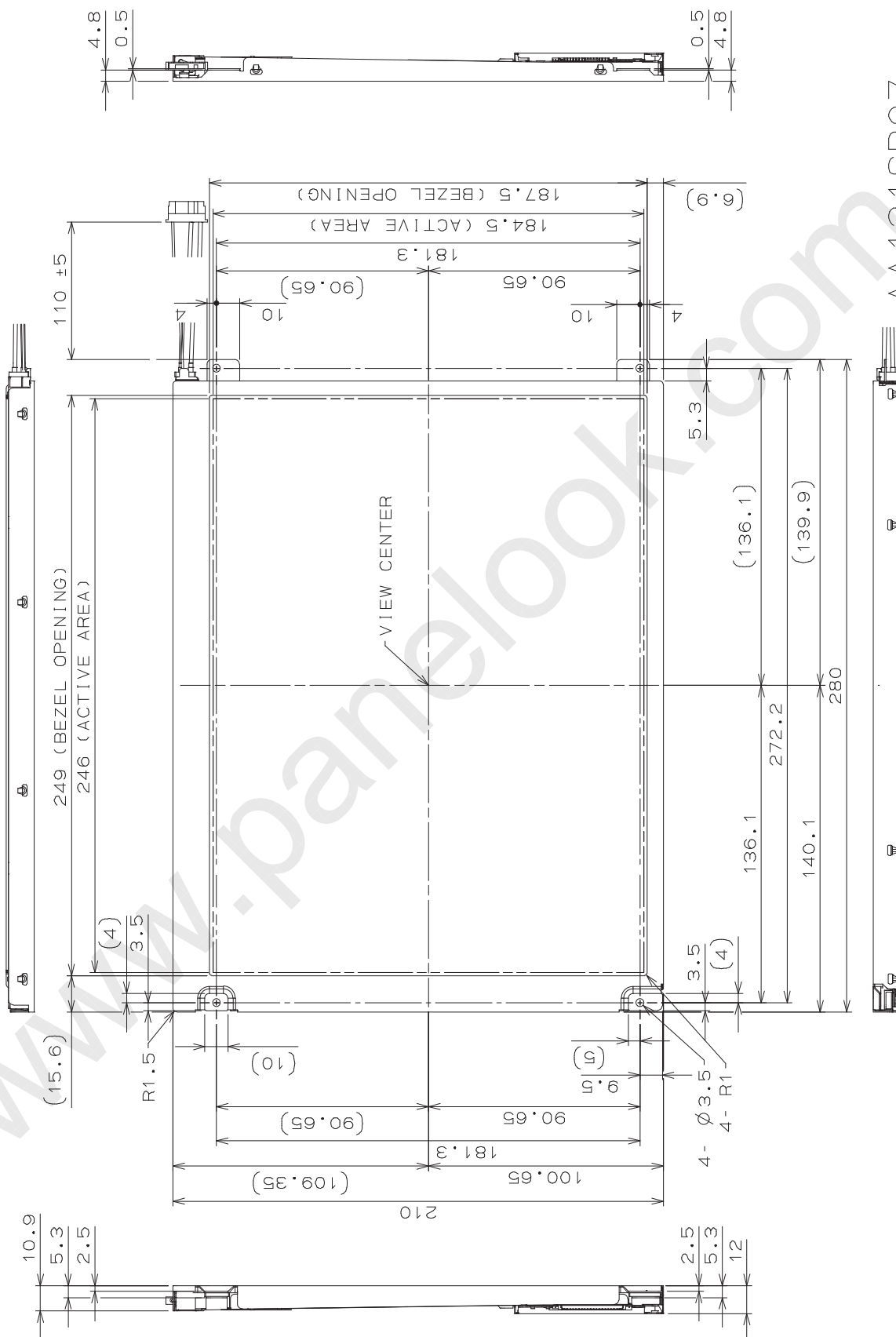


7. BLOCK DIAGRAM



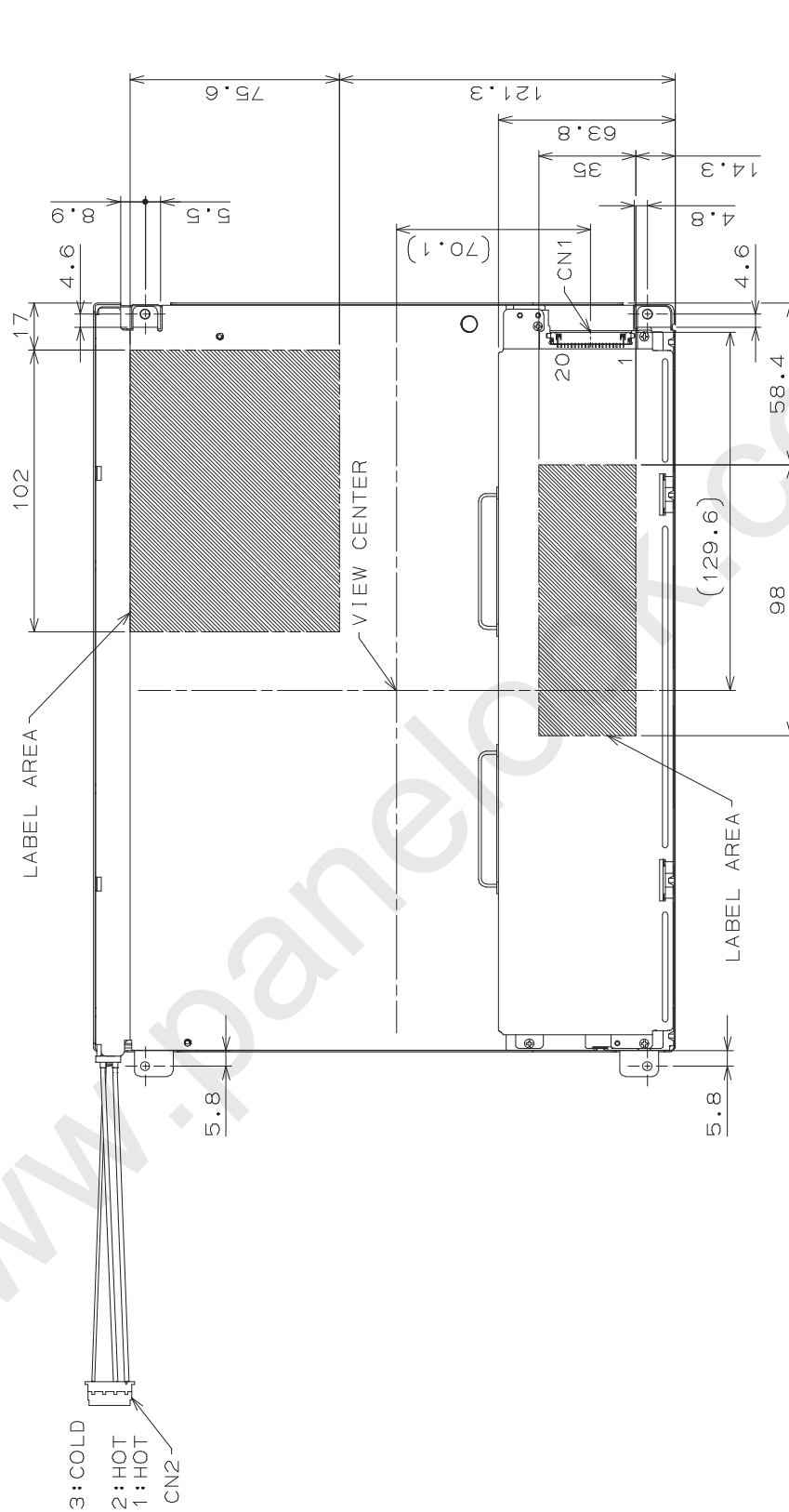
8. MECHANICAL SPECIFICATIONS

(1) Front Side



(Unit: mm)

(2) Rear Side



AA121SP07

1) Tolerance is $\pm 0.5\text{mm}$ unless noted.
 2) Third angle projection

CN1: F1-SEB20P-HFE(JAE)
 CN2: BHR-03(4-3)VS-1N(JST)

(Unit:mm)

9. OPTICAL CHARACTERISTICS

Ta=25°C, VCC=3.3V, Input Signals: Typ. values shown in Section 6

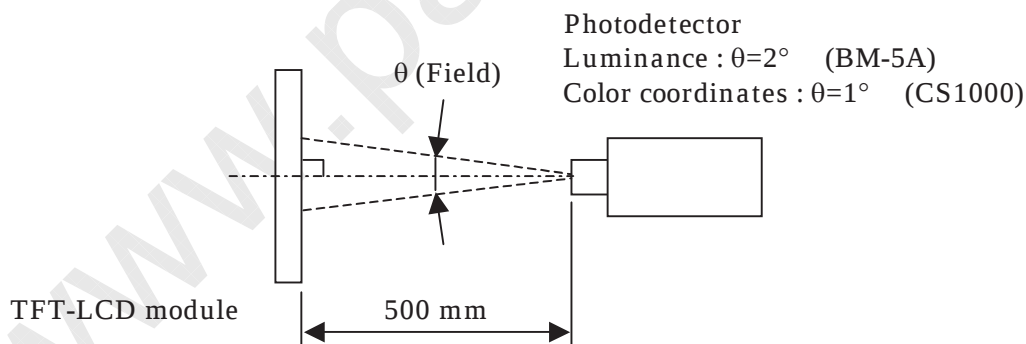
ITEM		SYMBOL	CONDITION	MIN	TYP	MAX	UNIT	Remarks
Contrast Ratio		CR	$\theta_V=0^\circ, \theta_H=0^\circ$	400	600	--	--	*1)*2)*5)
Luminance		L _w	$\theta_V=0^\circ, \theta_H=0^\circ$	360	450	--	cd/m ²	*1)*5)
Luminance Uniformity		ΔL_w	$\theta_V=0^\circ, \theta_H=0^\circ$	--	--	30	%	*1)*3)*5)
Response Time		t _r	$\theta_V=0^\circ, \theta_H=0^\circ$	--	4	--	ms	*1)*4)*5)
		t _f	$\theta_V=0^\circ, \theta_H=0^\circ$	--	12	--	ms	*1)*4)*5)
Viewing Angle	Horizontal	θ_H	CR ≥ 10	-65~65	-80~80	--	°	*1)*5)
	Vertical	θ_V		-40~60	-55~75	--	°	*1)*5)
Image sticking		t _{is}	2 h	--	--	--	2	*6)
Color Coordinates	Red	R _x	$\theta_V=0^\circ, \theta_H=0^\circ$	0.543	0.573	0.603	--	*1)*5)
		R _y		0.307	0.337	0.367		
	Green	G _x		0.288	0.318	0.348		
		G _y		0.506	0.536	0.566		
	Blue	B _x		0.130	0.160	0.190		
		B _y		0.125	0.155	0.185		
	White	W _x		0.283	0.313	0.343		
		W _y		0.299	0.329	0.359		

[Note]

These items are measured using CS1000(MINOLTA) for color coordinates, EZContrast(ELDIM) for viewing angle and CS1000 or BM-5A(TOPCON) for others under the dark room condition (no ambient light) after more than 30 minutes from turning on the lamp unless noted.

Condition: IL = 12.0 mArms, FL=43 kHz

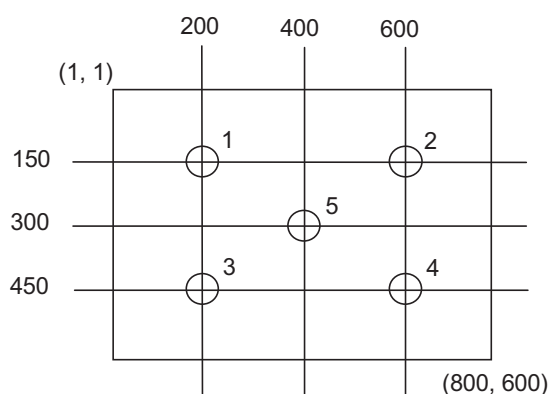
Measurement method for luminance and color coordinates is as follows.



The luminance is measured according to FLAT PANEL DISPLAY MEASUREMENTS STANDARD (VESA Standard).

*1) Measurement Point

Contrast Ratio, Luminance, Response Time, Viewing Angle, Color Coordinates: Display Center
Luminance Uniformity: point 1~5 shown in a figure below



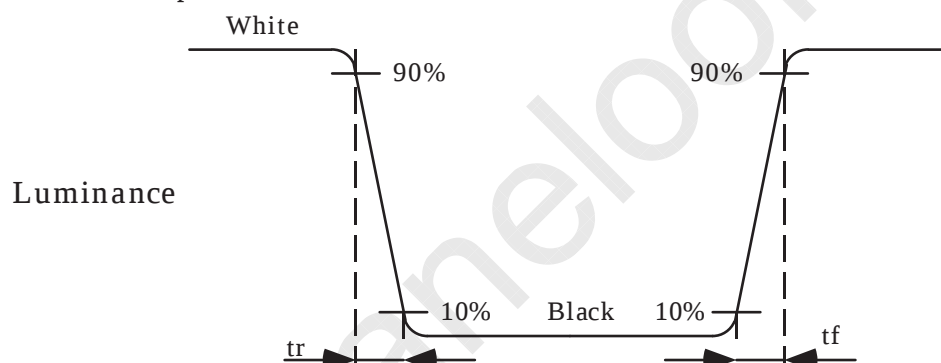
*2) Definition of Contrast Ratio

$CR = \text{Luminance with all white pixels} / \text{Luminance with all black pixels}$

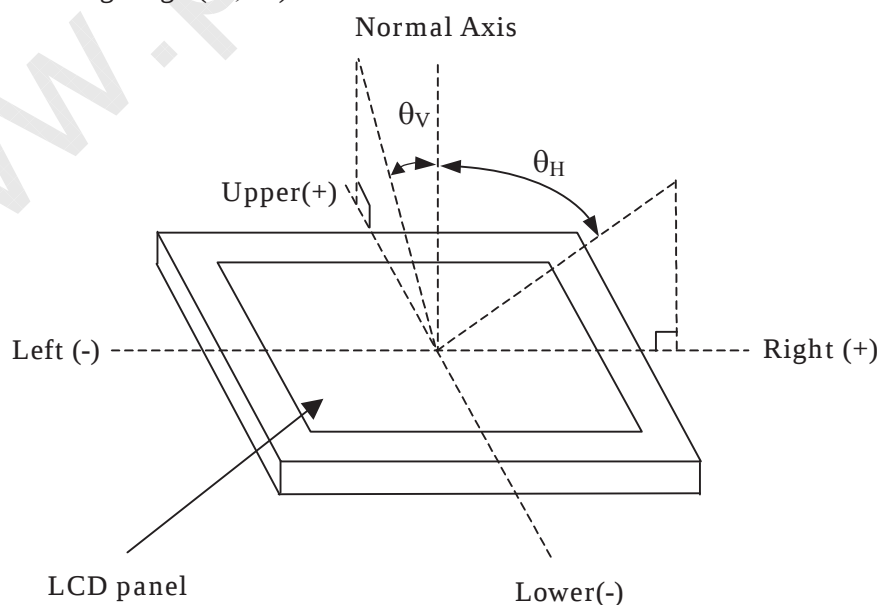
*3) Definition of Luminance Uniformity

$\Delta L_w = [L_w(\text{MAX}) / L_w(\text{MIN}) - 1] \times 100$

*4) Definition of Response Time

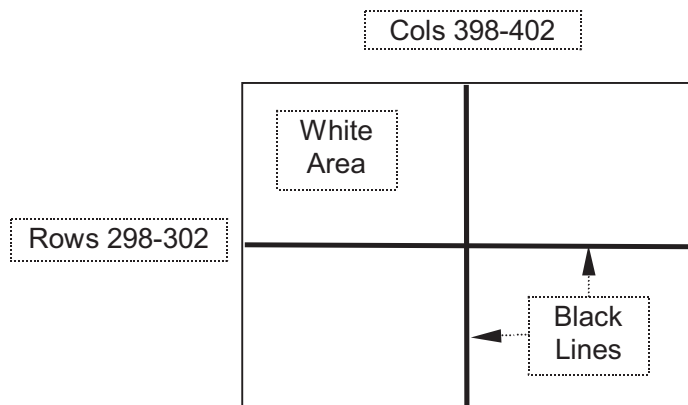


*5) Definition of Viewing Angle(θ_v , θ_H)



*6) Image sticking:

Continuously display the test pattern shown in the figure below for two-hours. Then display a completely white screen. The previous image shall not persist more than two seconds at 25°C.



TEST PATTERN FOR IMAGE STICKING TEST



10. RELIABILITY TEST CONDITION

(1) Temperature and Humidity

ITEM	CONDITIONS
HI H TEMPERATURE HI H HUMIDITY OPERATION	0 C, 90 RH, 2 0 (No condensation)
HI H TEMPERATURE OPERATION	80 C, 2 0
LO TEMPERATURE OPERATION	- 0 C, 2 0
HI H TEMPERATURE STORAGE	80 C, 2 0
LO TEMPERATURE STORAGE	- 0 C, 2 0
THERMAL SHOCK	0 C (1) ~ 80 C (1), 100 cycle

(2) Shock and Vibration

ITEM	CONDITIONS
SHOCK (NON OPERATION)	Shock pulse: 170 / $\sqrt{2}$ (150) Acceleration: 100 m/s ² , 2 Number of cycles: 10 cycles per test perpendicular to each other (total 30 cycles)
VIBRATION (NON OPERATION)	Vibration pulse: 9.8 / $\sqrt{2}$ (1.0) Acceleration: 100 m/s ² Frequency range: 5 to 500 Hz Frequency sweep rate: 0.5 octave / Duration: 10 cycles per 5 to 500 Hz (each test perpendicular to each other, total 30 cycles)

(3) Electrostatic Discharge

Test method: Electrostatic Discharge (ESD) test
 Part A: Normal operation, no ESD test required.
 Part B: For operation, ESD test required.
 Part C: For operation, ESD test required.



11. OTHER FEATURE

This LCD is eco friendly and RoHS compliant.

RoHS: Restriction of Hazardous Substances
Compliance Report



- . Please connect the external LCD to the ND or er to the effect of the external EMI.
- . Be sure to connect the external connector correctly.

(2) OPERATING PRECAUTIONS

- a. Please refer to the power supply connection and connection points in the manual.
- . Please do not cause any damage to the LCD module. There are a lot of things to be careful of. If there is any damage, the appearance of the LCD module will be different from the original.
- c. LCD module should be stored in a cool, dry place. Do not expose it to high temperature and humidity.
- . The temperature should be kept below 40°C. Please pay attention to the temperature of the LCD module. Do not touch the LCD module with bare hands.
- e. A coating should be applied to the surface of the LCD module to prevent it from being damaged by dust and moisture. Please take care of the LCD module in a clean and dry environment.
- . Please pay attention to the static electricity of the LCD module. Do not touch the LCD module with bare hands.
- . Please do not touch the LCD module with bare hands. Please prepare an antistatic bag for the LCD module.

(3) PRECAUTIONS WITH ELECTROSTATICS

- a. The LCD module is a CMOS IC. Do not touch the TFT LCD panel, as it may cause electrostatic damage. Please take care of the electrostatic protection of the LCD module.
- . Please use an electrostatic protection device to protect the LCD module from electrostatic damage.

(4) STORAGE PRECAUTIONS

LCD module should be stored in a cool, dry place. Do not touch the LCD module with bare hands. The LCD module should be stored in a clean and dry environment.

(5) SAFETY PRECAUTIONS

- a. Do not touch the LCD module with bare hands. Do not touch the LCD module with bare hands.
- . Do not touch the LCD module with bare hands. Do not touch the LCD module with bare hands.
- c. Be sure to refer to the power supply and connection points in the manual.



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(6) OTHERS

- a. A tro c e t t to LCD pa e a ca e eter orat o to po ar er , co or ter,
a ot er ater a , c e ra e t e a t o p a c aracter t c . P ea e o ot
e po e LCD o e er tro U tra o et ra ora o t e.
- . P ea e pa atte to to a pa e e o LCD o e ot to co tact t ot er ater a
pre er t a o e.
- c. For t e pac a o a , p ea e ee a o e t t e pac a pec cat o
ata eet.
- . P ea e o ot re e t e LED t c o ce re o e .